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EXPEDITED PROCEDURE
EXAMINING GROUP 2516

#14
4/18/97

35.G 1008 CIP1

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	)	Examiner: Ali Neyzari
NAOKI NISHIMURA	)	Group Art Unit: 2516
Appln. No.: 08/389,579	)	
Filed: February 15, 1995	)	
For: MAGNETOOPTICAL RECORDING MEDIUM AND METHOD FOR REPRODUCING INFORMATION FROM A MAGNETOOPTICAL RECORDING MEDIUM HAVING THREE LAYERS (As Amended)	)	April 17, 1997

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GROUP 2500

The Assistant Commissioner For Patents
BOX AF
Washington, D.C. 20231

SUBMISSION OF SWORN ENGLISH TRANSLATION

Sir:

Attached hereto is a sworn English translation of one of the priority documents in the subject application, namely Japanese Patent Application No. 5-038138, filed on February 26, 1993.

Since the filing date of this priority document predates the filing date of the patent to <u>Hirokane, et al.</u>, the <u>Hirokane, et al.</u> patent is not a reference against the

present application. Accordingly, the rejection of the claims over the Hirokane, et al. patent should be withdrawn.

Applicant's undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 347-8100. All correspondence should continue to be directed to our below-listed address.

Respectfully submitted,

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DECLARATION

I, KAZUO KATO, a subject of Japan residing at No. 10-602 Ohtsugaoka 3-17, Shonan-machi, Higashikatsushika-gun, Chiba 277, Japan, solemnly and sincerely declare:

That I have thorough knowledge of Japanese and English languages: and

That the attached pages contain a correct translation into English of the specification of the following Japanese Patent Application:

APPLICATION NUMBER	DATE OF APPLICATION
5-038138	February 26, 1993

I hereby declare that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true; and further, that these statements are made with the knowledge that willful false statements and the like so made, are punishable by fine or imprisonment, or both, under Section 1001, Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

Signed this 27th day of March, 1997

Kazuo Kato

KAZUO KATO

Name of Document: PATENT APPLICATION

Reference Number: 2467028

Filing Date: February 26, 1993

Address: Director-General of the Patent Office

Mr. WATARU ASOH

International Classification:

G112B 7/10

Title of the Invention:

A magnetooptical recording medium and information reproducing methods by using the medium

Number of the Claims: 3

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Indications of Fee:

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List of Filed Articles:

Specification	one copy
Drawings	one copy
Abstract	one copy

Number of General Power of Attorney: 9003707

Necessity of Proof: YES

NAME OF DOCUMENT

Specification

TITLE OF THE INVENTION

A Magnetooptical Recording Medium And Information Reproducing Methods Using The Recording Medium

CLAIMS

1. A magnetooptical recording medium comprising:

a first magnetic layer being an in-plane magnetization film at room temperature and raised temperatures, and changed to a perpendicular magnetization film at intermediate temperatures therebetween; and

a second magnetic layer composed of a perpendicular magnetization film.

2. A magnetooptical recording medium according to claim 1,

further comprising a third magnetic layer being interposed between said first magnetic layer and said second layer

and having Curie temperature lower than Curie temperatures of said first and second magnetic layers.

3. An information reproducing method using a magnetooptical recording medium, wherein

said magnetooptical recording medium comprises:

a first magnetic layer being a perpendicular magnetization

film at room temperature and changed to an in-plane magnetization film at raised temperatures; and

a second magnetic layer composed of a perpendicular magnetization film,

said method comprising the steps of:

changing said first magnetic layer to a perpendicular magnetization film, in its region within a light spot projection portion, by projecting a light spot onto said first magnetic layer;

aligning a magnetization direction of said region in a stable direction with respect to a magnetization direction based upon information recorded on said second magnetic layer; and

reproducing said information by utilizing magnetooptic effect of reflective light of said light spot.

DETAILED DESCRIPTION OF THE INVENTION

Field of the Industrial Use

The present invention relates to a magnetooptical recording medium for information recording and reproduction by irradiation with a laser beam by utilizing magneto-optic effect, and information reproducing methods using the recording medium.

Prior Art

A magnetooptical recording medium has become a subject of attention in the field of a rewritable and high recording density

recording method. In such a recording medium, information is recorded on the recording medium by forming a magnetic domain on a magnetic film in the medium by means of thermal energy of a laser beam from a semiconductor laser, and the information is read out from the medium, by utilizing magnetooptic effect. In recent years, the above noted trend is based on need for a larger amount of recording capacity, which can be attained by higher density of such a recording medium.

Incidentally, linear density of an optical disc, such as a magneto-optical recording medium, is largely dependent upon the wavelength of a laser beam and the numerical aperture of an objective lens used in an optical system for reproducing information.

That is, when the wavelength λ of a laser beam used in a reproducing optical system and the numerical aperture NA are determined, when the numerical aperture NA are determined, a bit periodicity, which is the limit of detection, is defined as $\lambda/2NA$.

Track density, however, is chiefly limited by crosstalk. The crosstalk is determined mainly by the laser beam distribution on a medium surface (profile) and is expressed as a function of $\lambda/2N$ similar to the bit periodicity mentioned above.

Thus, the wavelength of laser beam must be shortened and the numerical aperture of objective must be enlarged in order to increase recording density of the conventional optical disc.

However, there are limitations to improvement of the wavelength of a laser light and the numerical aperture of an objective. Techniques, then, have been developed, which improve the structure of a recording medium and a method of reading out data bits so that the linear recording density can be improved.

Japanese Patent Laid-Open No. Heisei 3-93058, for example, discloses a method which is performed by using a recording medium which is composed of a readout layer and a recording layer, orienting the direction of magnetization in the readout layer in a single direction, prior to signal reproduction, and thereafter, transferring signal held in the recording layer to the readout layer. Thus, it becomes possible to reduce interference between codes at the time of signal reproduction and to reproduce signal recorded at periodicity below the limit of light diffraction so that linear recording density can be improved.

Problems to be Solved by The Present Invention

However, the magnetooptical reproducing method of Japanese Patent Laid-open No. 3-93058 requires a step of aligning the magnetization direction of the readout layer in a single direction before laser beam projection. Thus, it is necessary to add a magnet for initializing the readout layer to a conventional apparatus. Because of such addition, problems have arisen such as more complicated structure of a magnetooptical recording apparatus, difficulty of down-sizing, and higher cost of an apparatus.

Means for Solving The Problems and function

It is an object of the present invention to provide a magnetooptical recording medium and information reproducing methods using the medium, which has simple configuration and canreproduce a signal of high S/N ratio whose periodicity is below the limit of light

diffraction.

The object is attained by a magnetooptical recording medium which comprises a first magnetic layer being an in-plane magnetization film at room temperature and raised temperatures and changed to a perpendicular magnetization film at intermediate temperatures therebetween, and a second magnetic layer composed of a perpendicular magnetization film.

Further, the object is attained by an information reproducing method using a magnetooptical recording medium which comprises a first magnetic layer being a perpendicular magnetization film at room temperature and changed to an in-plane magnetization film at raised temperatures, and a second magnetic layer composed of a perpendicular magnetization film. The method comprises a step of changing said first magnetic layer to a perpendicular magnetization film, in a region within a light spot projection portion, by projecting a light spot onto said first magnetic layer, a step of aligning a magnetization direction of said region in a stable direction with respec to a magnetization direction based upon information recorded on said second magnetic layer, and a step of reproducing said information by utilizing magnetooptic effect of reflective light of said light spot.

Embodiments

A magnetooptical recording medium and information reproducing methods using the medium, according to the present invention, will be described in detail with reference to figures.

A magnetooptical recording medium of the present invention

is composed of at least two layers: a readout layer which remains an in-plane magnetization film at room temperature and is changed to a perpendicular magnetization film when the temperature is raised, and returns to an in-plane magnetization film or its magnetization disappears, when the temperature is further raised; and a recording layer which is a perpendicular magnetization film at both room temperature and raised temperatures.

The readout layer is desirably composed of, for example, rare-earth and iron group metal amorphous alloy, such as GdCo, GdFeCo, GdTbFeCo, GdDyFeCo, NdGdFeCo, etc. Material is preferable which has small magnetic anisotropy or compensation temperature between room temperature and Curie temperature.

The recording layer is desirably composed of material having large perpendicular magnetic anisotropy and able to hold magnetized state stably, for example, rare-earth and iron group amorphous alloy, such as TbFeCo, DyFeCo, TbDyFeCo, etc.; or garnet; or platinum group and iron group periodical structure layer, such as Pt/Co and Pd/Co; platinum group and iron group alloy, such as PtCo and PdCo. Elements for improving corrosion resistance, such as Cr, Al, Ti, Pt, Nb and the like, may be added to magnetic layers, such as the readout layer, recording layer and so forth, respectively.

Futrher, dielectrics, such as SiNx, AlNx, TaOx, SiOx, etc., may be formed in addition to the readout and recording layers for improving interference effect. Al, AlTa, AlTi, AlCr, Cu, etc. may be formed for controlling thermal conductivity.

Still further, an intermediate layer for adjusting exchange-coupling force or magnetostatic coupling force, or an auxiliary layer

for assistance of recording or reproducing, may be formed. A protecting film may be used as protective coating which is composed of the above-mentioned dielectric or high polymer resin, furthermore.

The following description deals with an information reproducing method according to the present invention.

Referring to Fig. 1, data signal is recorded on the recording layer of the magnetooptical recording medium according to the present invention. One way of recording data signals is to modulate an external magnetic field while projecting a laser beam powerful enough to raise the temperature of the recording layer equal to or more than Curie temperature. Another way is to modulate laser power while applying a magnetic field in a recording direction, after eliminating data. Still another way is to modulate laser power while applying an external magnetic field.

In recording the data, the intensity of the laser beam is determined so that the temperature of a predetermined region within the beam spot can be raised near to Curie temperature, considering the linear velocity of the recording medium. Such determination on the intensity enables a recorded magnetic domain, which is less than the diameter of the laser beam spot, to be formed, and thus it is possible to record a signal having periodicity less than the limit of light diffraction.

When reproducing the data signal, a readout laser beam is projected onto the recording medium. At this time, the temperature in the region irradiated with the beam rises. Since the recording medium moves at a constant speed, the temperature distribution on the recording medium has a shape extending along the moving direction, as shown in

Fig. 4 or Fig. 5. In the temperature distribution, a part of the irradiated portion within the beam spot is a high-temperature area.

Regarding a magnetic thin film composed of a single layer, when saturation magnetization is named Ms and a perpendicular magnetic anisotropy constant is named Ku, an effective perpendicular magnetic anisotropy constant named K⊥ is defined in the following equation:

$$K\perp = Ku - 2\pi Ms^2$$

It is known that a chief magnetization direction is determined by the effective perpendicular magnetic anisotropy constant K⊥. A perpendicular magnetization film appears when K⊥ is positive and an in-plane magnetization film appears when K⊥ is negative.

Here, $2\pi Ms^2$ is energy of demagnetizing field. For example, when the readout layer has the temperature dependency of Ms and Ku as shown in Fig. 8, the in-plane magnetization film appears at room temperature, since

$Ku < 2\pi Ms^2$ and $K\perp < 0$.

At information reproduction, however, Ms of the readout layer decreases since the temperature increases. Thus, $2\pi Ms^2$ rapidly decreases and the inequality relation between $2\pi Ms^2$ and the perpendicular magnetic anisotropy constant Ku is inverted. As a result, $Ku > 2\pi Ms^2$, $K\perp > 0$

and the readout layer becomes a perpendicular magnetization film.

When the temperature is further raised and is over compensation temperature, the inequality relation between $2\pi Ms^2$ and perpendicular magnetic anisotropy constant Ku is again inverted. As a result, once more,

$Ku < 2\pi Ms^2$, $K\perp < 0$

and the readout layer becomes a in-plain magnetization film.

In other words, the saturation magnetization Ms and the perpendicular magnetic anisotropy constant Ku of the readout layer are set so that the magnetization of the readout layer is an in-plane magnetization film (which functions as a mask) in the highest-temperature and low-temperature (nearly room temperature) points within the light spot and is a perpendicular magnetization film ((which functions as a detection area (aperture)) in an intermediate-temperature portion thereof, as shown in Fig. 4, considering the intensity and linear velocity of the laser light at the information reproduction. By setting such conditions in this way, only the highest-temperature and low-temperature points within the laser beam spot become an in-plane magnetization film. The other portion (the intermediate-temperature portion between high-temperature portion and low-temperature portion), however, is a perpendicular magnetization film.

Since the readout layer, which is a perpendicular magnetization film, is magnetically coupled to the recording layer due to exchange-coupling, the magnetization direction in the readout layer is aligned along a stable direction with respect to the magnetization direction based on the information recorded on the recording layer. In other words, information recorded on the recording layer is transferred to the readout layer. The transferred information is converted to an optical signal by magneto-optical effect (more specifically, magneto-optical effect of a laser beam reflected from the readout layer) and is detected thereafter. In this case, no magneto-optical effect occurs in a portion within the laser beam spot where the readout layer is an in-plane magnetization film.

Further, above-mentioned embodiment is described as a case of magnetic coupling due to exchange coupling between the readout layer and the recording layer, but the recording and readout layers may be magnetically coupled to each other at the time of reproduction due to magnetostatic coupling. When the readout layer and the recording layer are layered directly or with an intermediate layer therebetween, the temperature region of a perpendicular magnetization shifts toward a lower value in comparison with a case where the readout layer and the recording layer are not layered, since exchange coupling force, magnetostatic coupling force or the like acts from the perpendicular magnetization film and thus Ku increases in appearance. However, by presetting the perpendicular magnetization temperature range, in a single layer structure, at a slightly higher value, it is possible that the readout layer is an in-plane magnetization film at both room temperature and higher temperatures, and is changed to a perpendicular magnetization film only at the intermediate temperatures therebetween even when the readout layer is layered along with the perpendicular magnetization layer.

Moreover, masking may be achieved at the highest-temperature point or region by disappearance of magnetization in the readout layer. However, signal level in reproducing might be slightly reduced since Curie temperature Tc of the readout layer needs to be lower than Tc of the recording layer.

The following is an example of an improved magnetooptical recording medium which contains an intermediate layer between a readout layer and a recording layer as shown in Fig. 2.

In this example, an intermediate layer is interposed between a

readout layer and a recording layer. Curie temperature of the intermediate layer is higher than room temperature and lower than those of the readout and recording layers. Material for the intermediate layer may be, for example, rare-earth and iron group amorphous alloy, such as TbFe, GdFe, TbFeCo and GdFeCo, or these alloys to which non-magnetic elements such as Al, Cu, Cr, etc. are added.

Meanwhile, in a portion where temperature increases due to projection of a readout laser beam, the readout layer is changed from an in-plane magnetization film to a perpendicular magnetization film, similar to the above-mentioned example. The intermediate layer can function as a mediator of exchange-coupling force from the recording layer to the readout layer until its Curie temperature is reached, and information in the recording layer is transferred to the readout layer.

However, the exchange-coupling between the readout and recording layers is interrupted at a high-temperature portion of the intermediate layer where its Curie temperature has been reached. In the portion, the perpendicular magnetic anisotropy constant of the readout layer rapidly decreases in appearance due to such loss of exchange-coupling force from the recording layer. Therefore, the magnetization direction of the readout layer becomes an in-plane direction again (see Fig. 6)

Thus, in such a case where the intermediate layer, which has a low Curie temperature, is formed, the readout layer can be an in-plane magnetization film at both of room temperature and higher temperatures and can be a perpendicular magnetization film at the intermediate temperature therebetween, in its layered structure together with the intermediate and recording layers, without using the readout layer which can return again, in its single layer state, to an in-plane

magnetization film at higher temperatures. Thus, the recording medium has the advantage that material can be selected from a wider range.

As mentioned above, the information reproducing method, which uses the magnetooptical recording medium according to the present invention, enables to reproduce information with high resolution even when the information is recorded in higher density, since a reproducing portion within the laser beam spot is located in a narrow zone between a high-temperature portion and a low-temperature portion, as shown in Fig. 4.

Further, it is expectative that still better C/N ratio can be attained because the detecting region is placed in a center of the laser beam spot.

The reason is that a position closer to the center of the spot is better for reproducing information in larger C/N ratio since intensity of the laser beam is a Gussian type and the intensity at a center of the laser spot is highest. (Generally, the center of the spot is not coincident with the center of temperature distribution of the recording medium when the medium moves. The highest temperature point shifts toward the moving direction of the medium. Therefore, when the highest-temperature point is selected as a detectable area, the detecting area will be deviated from the center of the spot (see Fig. 5))

Experimental examples of the present invention will be described hereinafter. They are illustrative and not restrictive within the scope of the present invention.

[First experimental example]

Targets of Si, Tb, Gd, Fe, Co and Al are installed in a DC magnetron sputtering equipment, and a glass substrate is held on a holder. Thereafter, air is vacuum-exhausted from a chamber to establish a high vacuum level of less than 1×10^{-5} Pa by using a cryosorption pump.

Ar gas is introduced into the chamber until the level of 0.3 Pa of Ar gas is reached, while vacuum-exhausting air. Thereafter, a SiN layer is deposited to a thickness of 700Å as an interferrence layer; a GdFeCo layer is deposited to a thickness of 400Å as a readout layer; a TbFeCo layer is deposited to a thickness of 400Å as a recording layer; and then another SiN layer is deposited to a thickness of 800Å as a protective film; and then, a layered film, which has the structure as shown in Fig. 3 (a), is attained.

When the SiN layer is formed, N_2 gas is introduced in addition to the Ar gas and the deposition is performed by DC reactive sputtering. The GdFeCo and TbFeCo layers are formed by utilizing spontaneous sputtering, while applying DC power to targets of Gd, Fe, Co and Tb, respectively.

The composition of the GdFeCo layer is set so that its compensation and Curie temperatures are 270℃ and over 400℃, respectively.

The composition of the TbFeCo layer is adjusted so that its compensation and Curie temperatures are less than room temperature and 230℃, respectively.

It has been found that Kerr effect (residual Kerr rotation angle), when no magnetic field is applied, appears only in a range from 130℃ to 180℃ and a perpendicular magnetization film is established as shown in Fig. 10, by measuring the residual θK when magnetic field is

zero while the temperature of the layered films is raised.

[Second experimental example]

Next, a magnetooptical recording medium is fabricated which has the same layer structure as that of the above-mentioned experimental example expect that a polycarbonate substrate having a diameter of 130 mm with pregrooves is installed.

Then, recording-reproducing characteristics of this magnetooptical recording medium are measured.

A measuring instrument comprises an objective of 0.55N.A. and a projector for outputting a laser beam of 780 nm wavelength. Power for recording is preset at 8 mW and linear velocity is 9 m/sec. Then, 2-10 MHz carrier signal is recorded on the recording layer with intervals of 2 MHz as an interference layer by using a field modulation system. The record-frequency dependency of C/N ratio is measured. The result of measuring is shown in Table 1. The reproducing power is set so that C/N ratio is maximized. Record magnetic field is $\pm$500 Oe.

[Third experimental example]

Targets of Si, Tb, Gd, Fe Co and Al are installed in a DC magnetron sputtering equipment, and a polycarbonate substrate is held on a holder. Thereafter, air is vacuum-exhausted from a chamber to establish a high vacuum level of less than 1×10^{-5} Pa by using a cryosorption pump. Ar gas is introduced into the chamber until the level of 0.3 Pa of Ar gas is reached, while vacuum-exhausting air.

Thererafter, a SiN layer is deposited to a thickness of 830 Å as an interferrence layer; a GdFeCo layer is deposited to a thickness of 400 Å as a readout layer; a TbFeCoAl layer is deposited to a thickness of 100 Å as an intermediate layer; a TbFeCo layer is deposited to a thickness of 300 Å as a recording layer; and then another SiN layer is deposited to a thickness of 700 Å as a protective film; and thus, a magnetooptical recording medium as shown in Fig. 3 (b) is fabricated.

When the SiN layer is formed, N_2 gas is introduced in addition to the Ar gas, and the deposition is performed by DC reactive sputtering. The GdFeCo and TbFeCo layers are formed by utilizing spontaneous sputtering, while applying DC power to targets of Gd, Fe, Co and Tb, respectively. The composition of those layers is adjusted by controlling applied DC power to the respective targets.

The GdFeCo readout layer is set so that its compensation and Curie temperatures are 250℃ and over 310℃, respectively.

The TbFeCoAl intermediate layer is adjusted so that its Curie temperatures is 150℃.

The TbFeCo recording layer is adjusted so that its Curie temperature is 210℃.

A measuring instrument comprises an objective of 0.55N.A. and a projector for outputting a laser beam of 780 nm wavelength. Power for recording is preset at 8.2 mW and linear velocity is 9 m/sec. Then, 6-14 MHz carrier signal is recorded in the recording layer with intervals of 2 MHz by using a field modulation system. The record-frequency dependency of C/N ratio is measured. Record magnetic field is ±300 Oe. The result of measurement is shown in Table 1.

Similarly, 4th to 9th experimental examples are shown in Table

1.

[Comparative experimental example]

Conditions of this comparative experimental example of a magnetooptical recording medium are the same as the first experimental example except that compensation and Curie temperatures of the readout layer are 280℃ and 300℃, respectively. The layered layers have the temperature dependency of residual θK as shown Fig. 11. Then, the deposition is performed on the polycarbonate substrate, similar to the second experimental example. After the magnetooptical recording medium is thus fabricated, the record-frequency depedency of C/N ratio has been similarly inspected. The result is shown in Table 1.

Table 1

	readout layer		intermediate layer		recording layer		C/N (dB) mark length		
	comp.	thick. (Å)	comp.	thick. (Å)	comp.	thick. (Å)	0.3 μm	0.4 μm	0.5 μm
example 1, 2	GdFeCo	400	non		TbFeCo	400	33	43	46
example 3	GdFeCo	400	TbFeCoAl	100	TbFeCo	300	32	41	44
example 4	GdFeCo	350	non		TbFeCo	370	30	42	45
example 5	GdTbCo	300	non		TbFeCo	400	30	41	44
example 6	GdFeCo	400	non		DyFeCo	380	32	40	44
example 7	NdGdFeCo	370	non		TbFeCo	400	30	42	46
example 8	GdFeCo	400	TbFeCoCu	50	TbFeCo	450	32	42	45
example 9	GdFeCo	360	GdFeCo	80	TbFeCo	300	35	44	46
com. ex.	GdFeCo	400	non		TbFeCo	400	24	37	42

Advantages of The Present Invention

Using reproducing methods according to the present invention enable a simply configured apparatus having no magnet for initilization (a prior apparatus) to read out a magnetic domain less than the diameter of a laser beam spot and achieve high density recording whose linear recording density is further improved.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematic view illustrating a magnetized situation of a magnetooptical recording medium of the present invention.

Fig. 2 is a schematic view illustrating another magnetized situation of the magnetooptical recording medium.

Fig. 3A is a schematic view showing the layer structure of the magnetooptical recording medium shown in Fig. 1.

Fig. 3B is a schematic view showing the layer structure of the magnetooptical recording medium shown in Fig. 2.

Fig. 4 is a view explaining an information reproducing method by using the magnetooptical recording medium shown in Fig. 1.

Fig. 5 is a view explaining an information reproducing method by using the magnetooptical recording medium different from that of the present invention.

Fig. 6 is a view explaining an information reproducing method by using the magnetooptical recording medium shown in Fig. 2.

Fig. 7 is a view illustrating the relation between the beam intensity of a light spot and detection region within the light spot.

Fig. 8 is a graph illustrating an example of the temperature dependencies of $2Ms^2$ and the perpendicular magnetic anisotropy constant Ku of a readout layer of the magnetooptical recording medium according to the present invention.

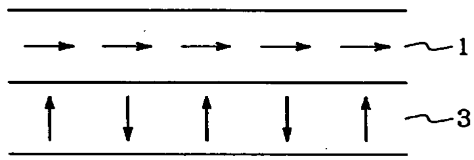
Fig. 9 is a graph illustrating an example of the temperature dependency of a residual θK (when a magnetic field = 0) of the magnetooptical recording medium according to the present invention.

Fig. 10 is a graph illustrating an example of the temperature dependency of a residual θK (when a magnetic field = 0) of a magnetooptical recording medium according to an comparative experimental example.

【書類名】　図面　Name of Document Drawings

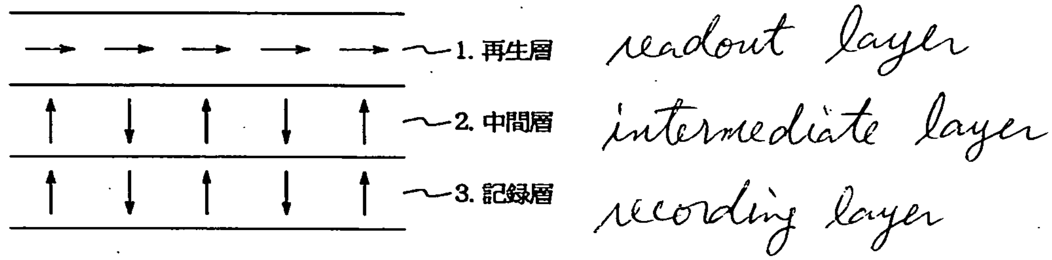
【図１】

Fig. 1



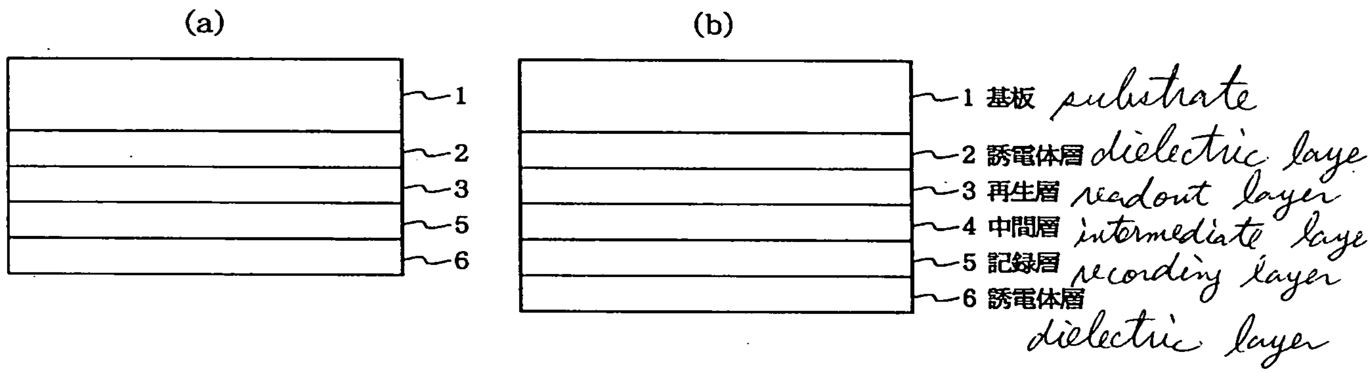
【図２】

Fig. 2


1. 再生層
2. 中間層
3. 記録層
readout layer
intermediate layer
recording layer

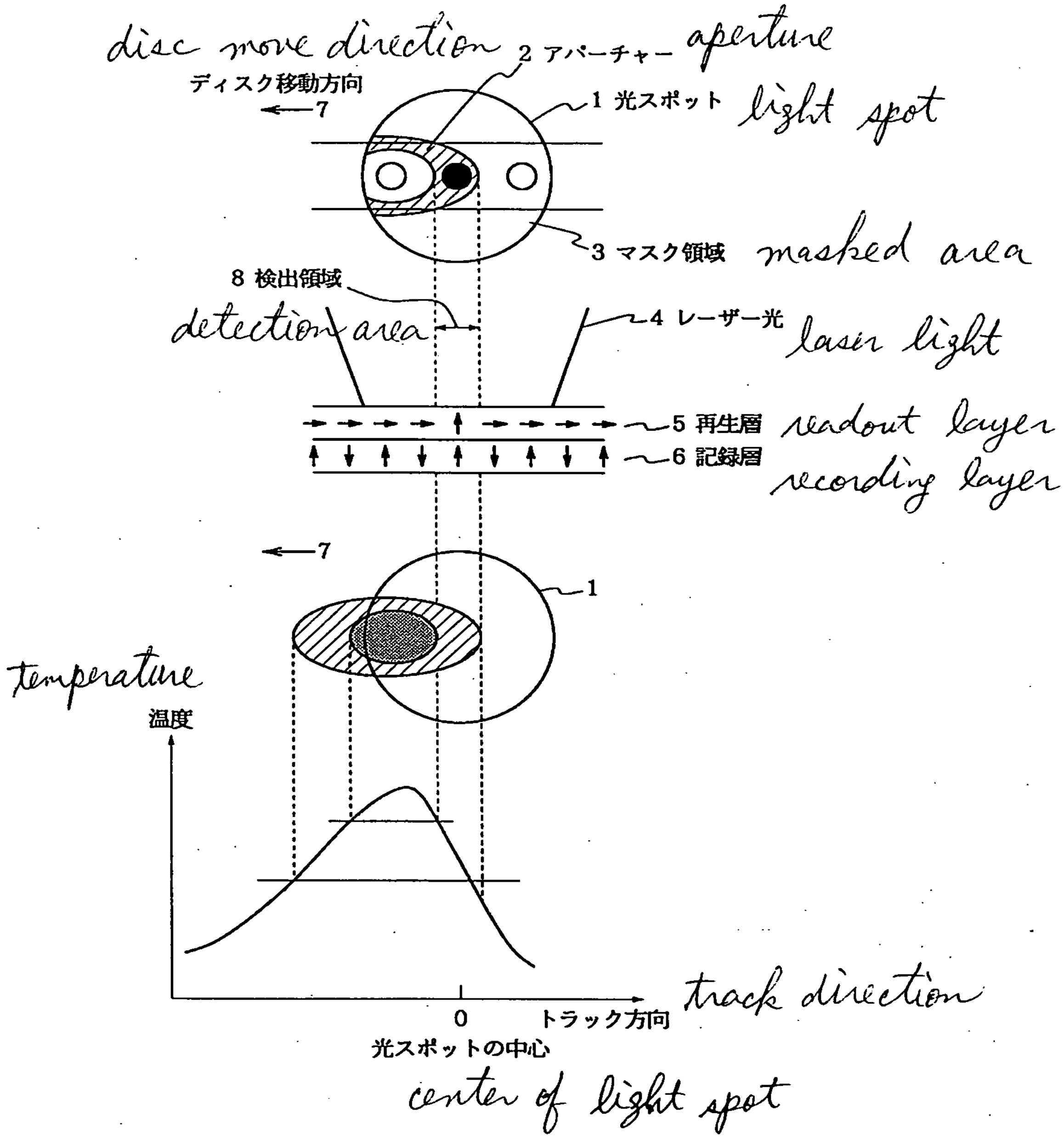
【図３】

Fig. 3


(a)
1
2
3
5
6
(b)
1 基板 substrate
2 誘電体層 dielectric laye
3 再生層 readout layer
4 中間層 intermediate laye
5 記録層 recording layer
6 誘電体層 dielectric layer

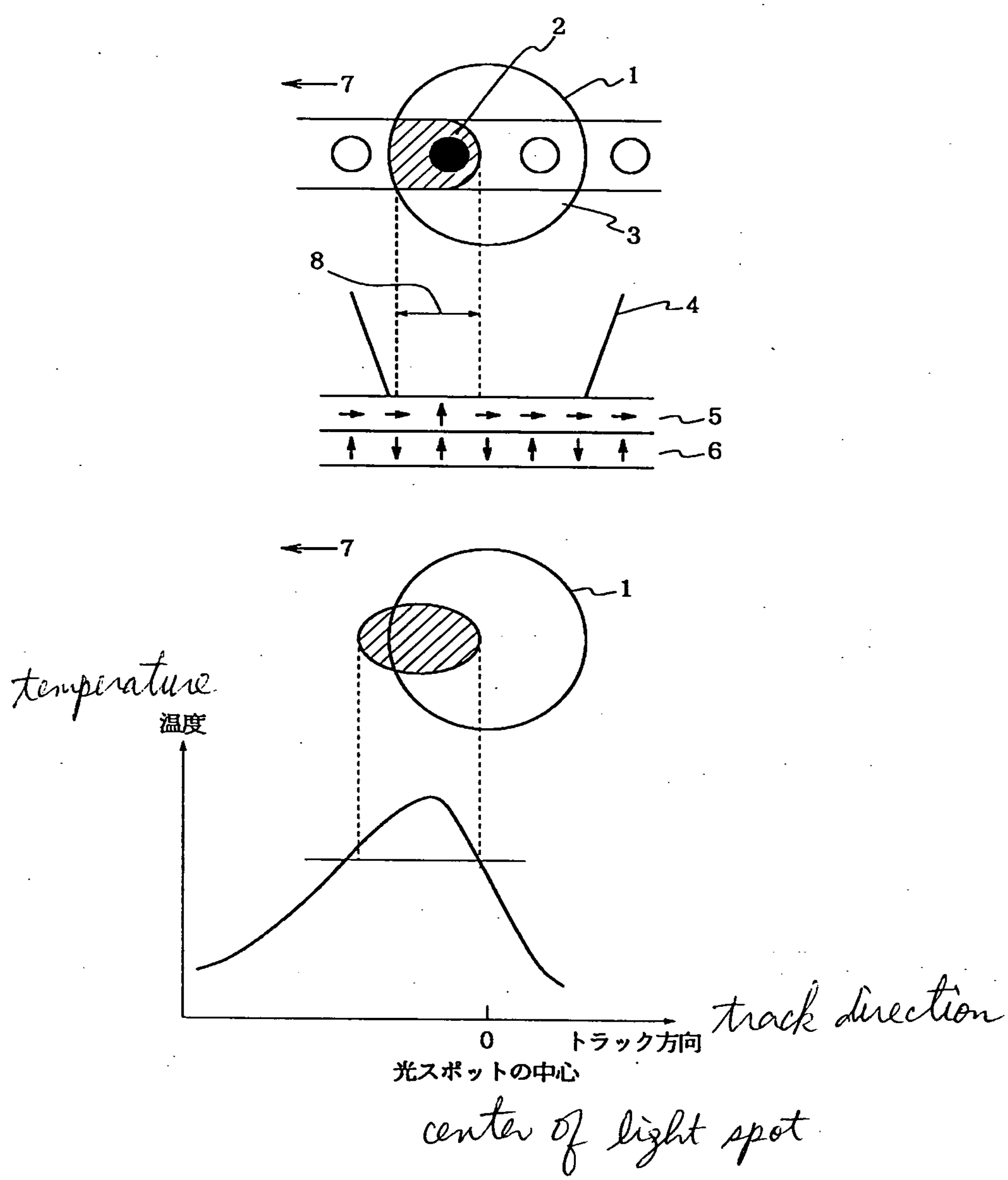
【図４】

Fig. 4

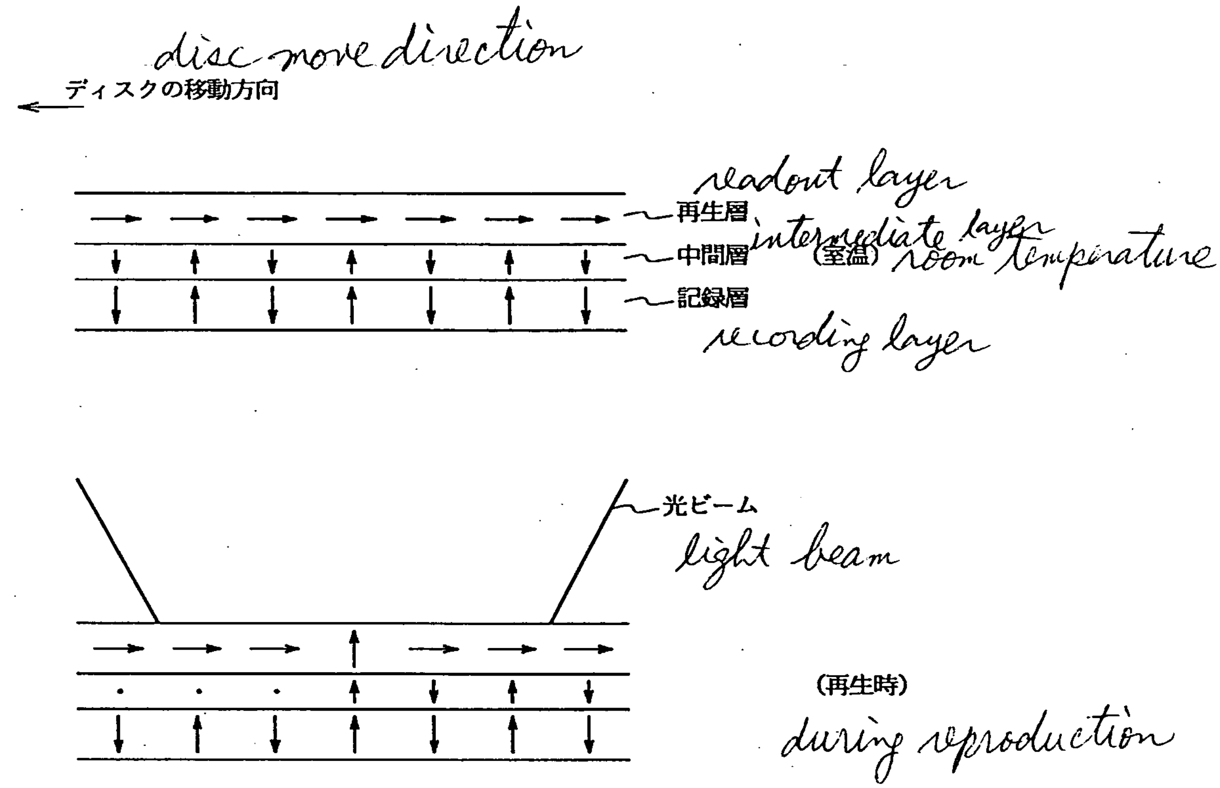

disc move direction
ディスク移動方向
7
2 アパーチャー aperture
1 光スポット light spot
3 マスク領域 masked area
8 検出領域
detection area
4 レーザー光 laser light
5 再生層 readout layer
6 記録層 recording layer
7
1
temperature
温度
0
トラック方向 track direction
光スポットの中心
center of light spot

【図５】

Fig. 5


2
7
1
3
8
4
5
6
7
1
temperature
温度
0
トラック方向
track direction
光スポットの中心
center of light spot

【図６】

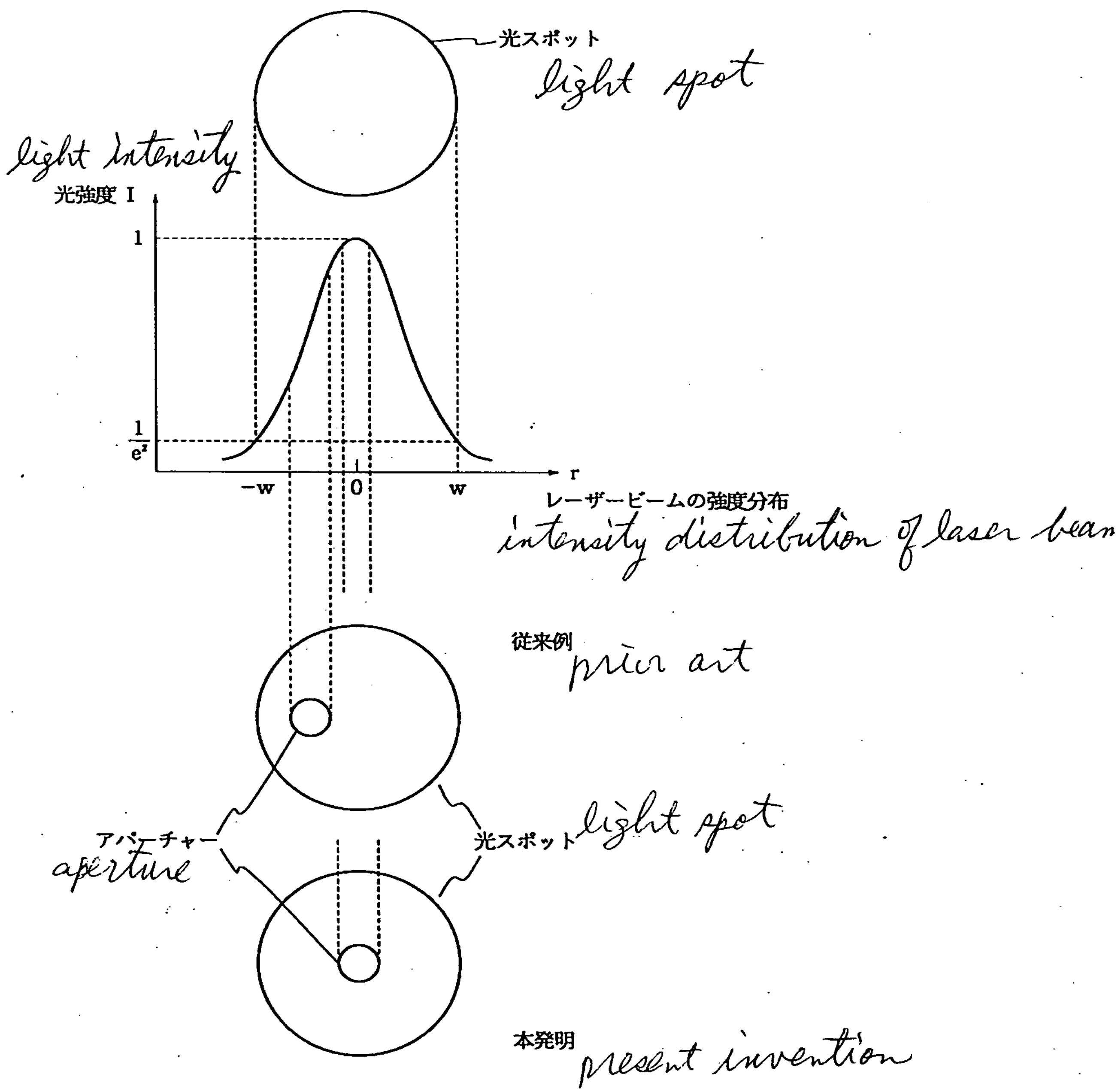


(・は磁化消失状態を表す)

Dot indicates magnetization disappearance state

【図７】

Fig. 7


光スポット
light spot
light intensity
光強度 I
1
$\frac{1}{e^2}$
r
−w
0
w
レーザービームの強度分布
intensity distribution of laser beam
従来例
prior art
アパーチャー
aperture
光スポット
light spot
本発明
present invention

【図８】

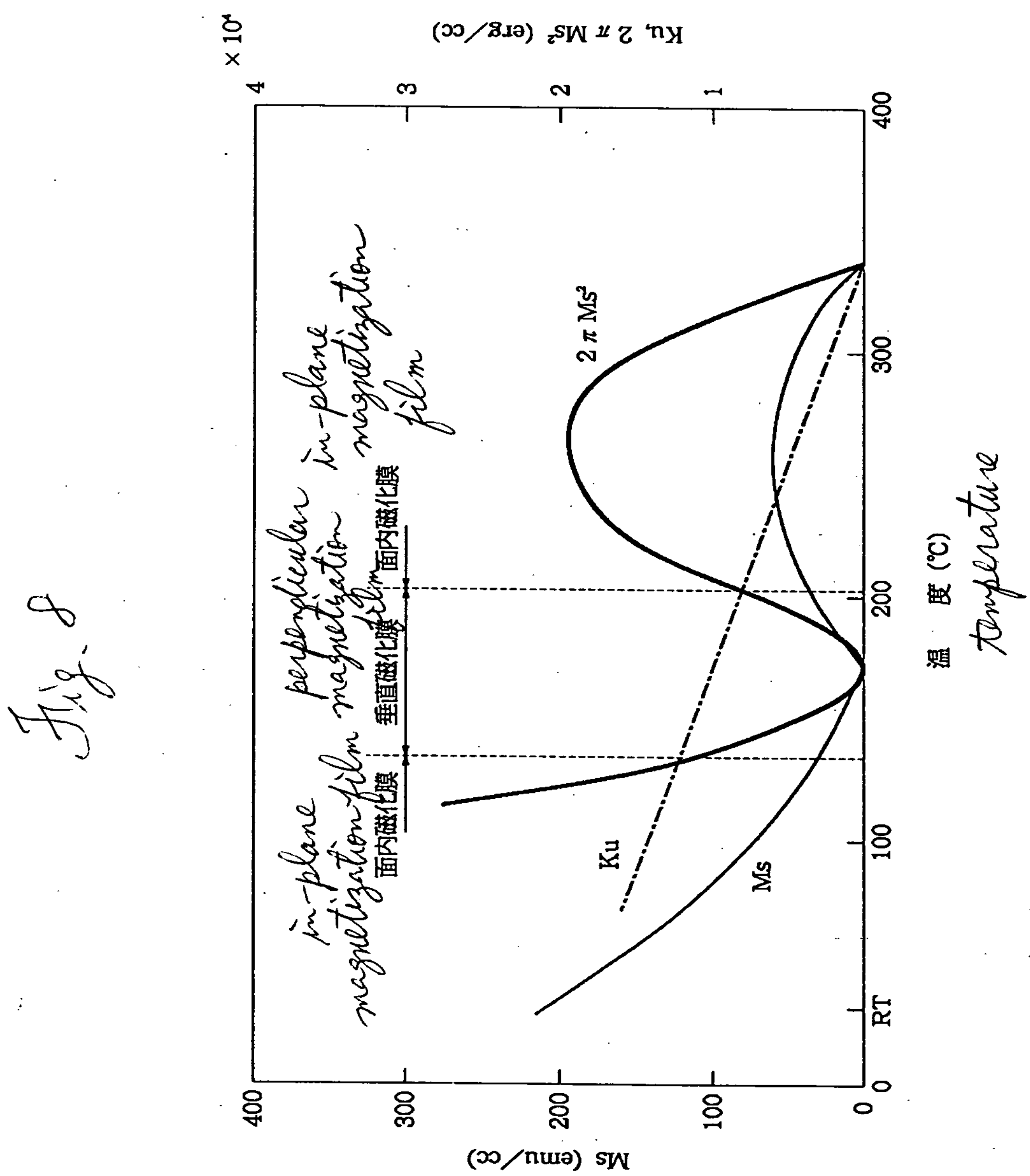
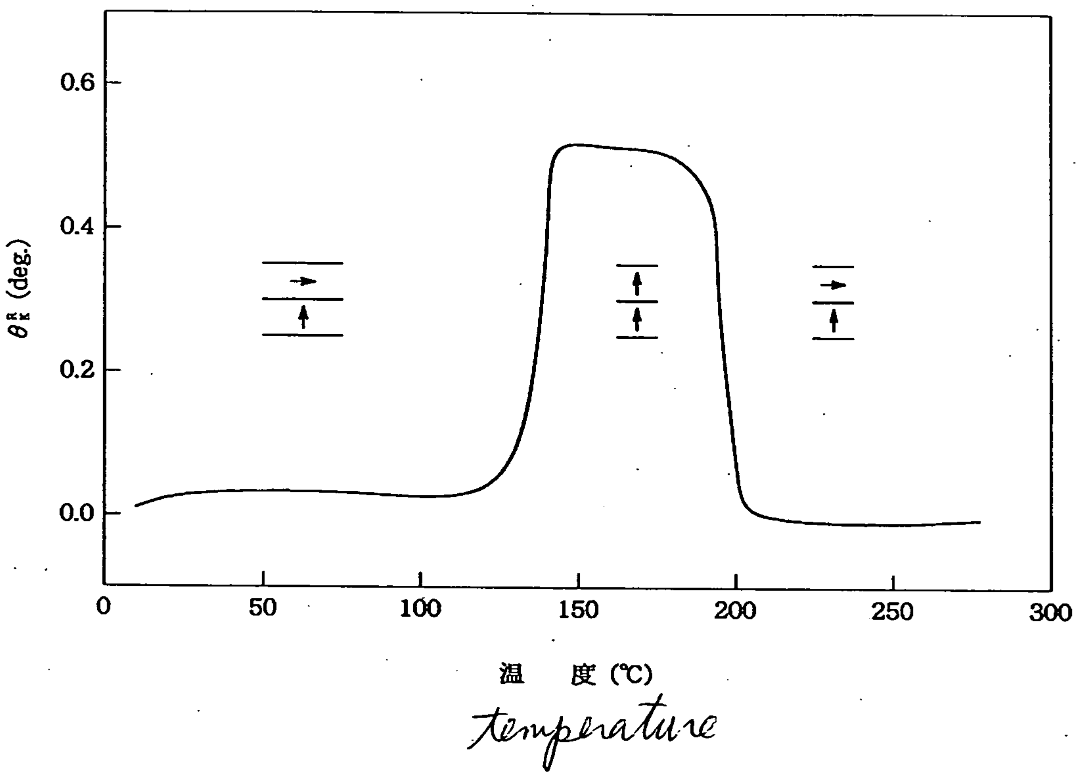


Fig. 8
Ku, 2 π Ms² (erg/cc)
× 10⁴
4
3
2
1
2 π Ms²
Ku
Ms
in-plane magnetization film
perpendicular magnetization film
in-plane magnetization film
面内磁化膜
垂直磁化膜
面内磁化膜
Ms (emu/cc)
400
300
200
100
0
RT
温　度 (℃)
temperature

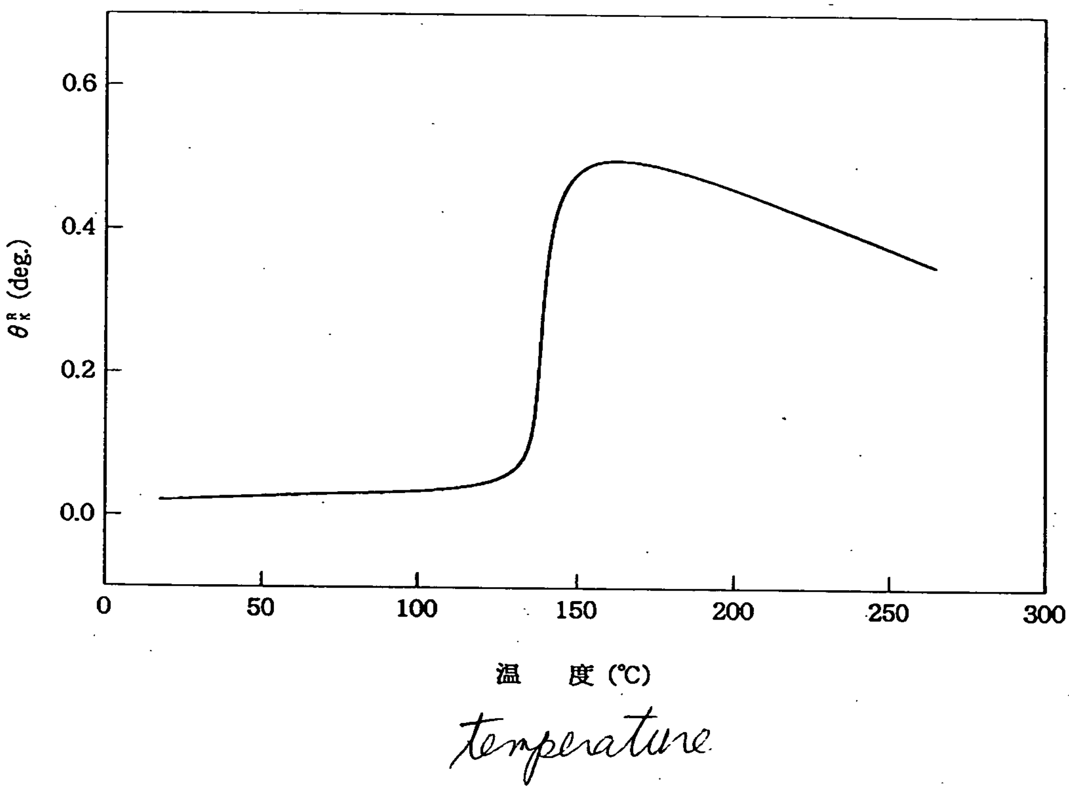
【図９】

Fig-9



【図１０】

Fig. 10



NAME OF DOCUMENT

Abstract

SUMMARY

OBJECT

It is an object of the present invention to provide a magnetooptical recording medium in which it is able to reproduce a signal, whose periodicity is below the limit of light diffraction, by simple configuration, and information reproducing methods using the medium.

CONSTITUTION

An information reproducing method uses a magnetooptical recording medium which comprises a first magnetic layer being a perpendicular magnetization film at room temperature and changed to an in-plane magnetization film at raised temperatures, and a second magnetic layer composed of a perpendicular magnetization film. The method comprises a step of changing said first magnetic layer to a perpendicular magnetization film, in a region within a light spot projection portion, by projecting a light spot onto said first magnetic layer, a step of aligning a magnetization direction of said region in a stable direction with respect to a magnetization direction based upon information recorded on said second magnetic layer, and a step of reproducing said information by utilizing magnetooptic effect of reflective light of said light spot.

SELECTED FIGURE

Figure 4